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ABSTRACT

Meat is produced from food animals, for better nutrition and improves the health of the consumer. Chemical residues in meat are of public health concern. Such residues may originate from the exposure of the living animals to undesirable substances and residues of veterinary drugs such as antibiotics, antihelminthic drugs and growth promoters, pesticides, heavy metals, natural toxins etc. Food safety objectives aim to identify the hazards and introduce new techniques to prevent the exposure of consumers to harmful chemical substances. The use of drug is wide in the food animals to control infections, diseases and improve the growth of the animal. But usages of drugs in food animals, provide more disadvantages. It affect the human health, particularly relates to antibiotic resistance and toxicity. So better analytical techniques and Maximum Residue Limit values will be needed to manage the use of drugs and other residues in meat production.

Key words: antibiotics, meat production, chemical substances, veterinary drugs

1. INTRODUCTION

Meat is produced from food animals, for better nutrition and improves the health of the consumer. Food animals are affected by large number of drugs used to control the infections, curing the diseases and to improve the growth of the food animal. Food additives to be added in the feedstuff of the food animals, ass a growth promoters, aimed to treat the diseases, improving the production cycle. This title will be discussed with residues from chemical substances of animal origin caused by veterinary drugs, growth promoters and toxins in meat and meat products.

2. VETERINARY DRUGS

Veterinary drugs are generally used in farm animals for therapeutic and prophylactic purposes and they include a large number of different types of compounds which can be administered in the feed or in drinking water. In some cases, the residues may proceed from contaminated animal feedstuffs (Mc Evoy, 2000).

3. ANTIBIOTIC DRUGS

Antibiotics used as a growth promoter, therapeutics, in prophylaxis (Nisha, 2008). Commonly used antimicrobial agents include penicillin,

sulphonamides, chlortetracycline, β-lactams.

Penicillin has low toxicity, hypersensitivity reactions, especially skin rashes, gastro intestinal disturbances including diarrhea, nausea and vomiting may also sometimes appear. Some studies have indicated that sensitive people have experienced allergic reactions, dermatitis caused by consuming residues present in meat/milk (Medina et al., 2008).

Sulphonamides are commonly used on food producing animals as growth promoters and as therapeutic and prophylactic drugs because they are antibiotics against a variety of bacterial and protozoan infections (Long, Hsieh, Malbrough, Short, and Barker, 1990; Mandell and Sande, 1990). Sulphonamides are also potentially carcinogenic, causing considerable debate about food safety (Kim and Park, 1998; Schwarz and Chaslus-Dancla, 2001). In common with other veterinary medicines authorized for food animal use, a community MRL of 100µg/kg has been assigned for all sulphonamides in meat/milk (Anon, 1990).

There are no reports in the literature of β-lactam contamination of animal feeding stuff giving rise to violative residues in animal products (Ec Evoy, 2002).

Chloramphenicol most serious toxic effect is bone marrow depression which is generally dose related reversible but can sometimes be fatal in patients who are probably genetically predisposed. Chloramphenicol may also cause neuritis, encephalopathy with dementia and ototoxicity; its use is restricted in many countries, while it totally banned for use in food producing animals within the European Union and the USA. Chloramphenicol and its metabolites could be genotoxic (Lozano and Arias, 2008).

Fluoroquinolones antibiotics in chicken and an increase in campylobacter resistant in humans (Smith et al., 1999; Endtz et al., 1991). Because of these concerns, the FDA has banned the extra-label use of these drugs in food producing animals.

β-agonists are a class of drugs where the health concern in not antibiotic resistance but acute poisoning from the drug residues themselves. Clenbuterol, the β-agonist most commonly given to animals illegally to increase their muscle mass, has been reported to cause human illness in Europe (Mitchell and Dunnavan, 1998). The most commonly identified by residue analysis include clenbuterol, mabuterol, cimaterol, ractopamine and salbutamol. These drugs are altering the growth pattern of ruminants. The net effect when added to the feed of cattle is to reduce the fat content of the carcass, producing leaner meats which are favored by health consious consumers. For this effect the dose required is several times greater than therapeutic. At this concentration significant residues accumulate in edible tissues such as liver or kidney (Meyer and Rinke, 1991; Elliott et al., 1993 a,b).

Antimicrobial drugs	Acceptable daily intake (ppb)	Target tissue (ppm)			
		Muscle	Liver	Kidney	Fat
Ampicillin	-	0.050	0.050	0.050	0.050
Benzyl /Procaine	0-30	0.050	0.050	0.050	0.050
Benzyl Penicillin Cloxacillin	-	0.300	0.300	0.300	0.300
Erythromycin	-	0.400	0.400	0.400	0.400
Gentamicin	0-20	0.100	0.200	0.500	0.100
Sulfadimidine	0-50	0.100	0.100	0.100	0.100
Sulfanamides (combinations)	0-50	0.100	0.100	0.100	0.100
Streptomycin	0-50	0.600	0.600	0.100	0.600
Oxytetracycline	0-30	0.100	0.100	0.100	0.100
Tetracyclines (OTC+CTC+TC)	0-30	0.100	0.100	0.100	0.100
Trimethoprim	-	0.050	0.050	0.050	0.050

'-' Data not available
Source : CAC (2005)

4. ANTIHELMINTHICS DRUGS

Antihelminthic drugs used to remove internal parasites such as liver flukes and nematodes are important in animal production systems.

Residues of benzimidazole compounds can occur in meat and meat products, it is necessary to observe withdrawal times for meat and milk after therapy. In tissues, the benzimidazoles may be unbound or bound to protein. The unbound drugs or metabolites are most likely to be associated with the toxic effects. The tightly bound protein residues, which persist in the tissues for longer periods of time, are thought to be less significant toxicologically (Delatour and Parish, 1986).

Levamisole is a broad-spectrum synthetic anthelmimtic used for the control of lung worms and GI nematodes in cattle, sheep, swine and other food animals (Hsu, 1980).

Disclorvos has an acceptable antihelminthic spectrum in cattle and sheep, but it does not have FDA approval for use in ruminants due to its suspected carcinogenic effects and narrow safety margin (Botsoglou and Fletouris, 2000; Gracey, 1992).

6. EFFECTS OF VETERINARY DRUGS ON MEAT QUALITY

The meat tends to be tougher because there is an increase in connective tissue production and also a higher rate of collagen cross-linking (Moloney, Allen, Joseph and Tarrant, 1991) as well as an increase in the insoluble fraction of the intramuscular collagen (Miller et al., 1989; Miller, judge, and Schanbacher, 1990).

Another factor, which is important from the point of view of meat tenderness, consists in the inhibitory action that these substances may exert against muscle proteases, enzyme responsible for protein breakdown in postmortem meat (Moloney et al., 1991). For instance, mofibrillar protein fragmentation has been reported to be decrease in agonist-treated animals probably due to calpains inhibition by β-agonists (Fiems, Buts, Boucquo, Demeyer and Cottyn, 1990; Barbosa et al., 2005).

7. PESTICIDES

The chlorinated hydrocarbons are extremely durable, persistent and bio accumulating compounds.

DDT (dichlorodiphenyltrichloroethane) was one of the most successful synthetic insecticides and continued in general use for many years. However, the bioaccumulation that occurred in various food chains eventually resulted in the banning of organochlorine pesticides by the 1970s. Unacceptably high tissue concentration has also occurred in broilers fed on treated grain. The organophosphates (eg: coumaphos, malathio, dichlorophos, diazinon) are extremely toxic to mammals but are highly efficient insecticides. Herbicides or preservatives absorbed by animals or poultry they cause disagreeable flavors in meat or egg products (Graceys 1992).

Maximum residue limits (MRLs) of pesticides (ppm) in meat.

Pesticide	PFA Rules Meat & Poultry	Codex Standards Cattle meat	U.S Standard Cattle meat
Aldrin/dieldrin	0.2	0.2	0.3 (fat)
Chlordane	-	0.05	0.3 (fat)
Aldicarb	-	0.10	0.01
Carbaryl	-	0.10	0.10
Chlorpyrifos	0.1	2.0	0.2
Cypermethrin	0.2	0.02	0.05
DDT	7.0 (fat)	5.0 (fat)	5.0 (fat)
Decamethrin/deltamethrin	-	0.03	-
Endosulfan	-	0.10	0.2
Fenvalerate	1.0	1.5	1.5
Heptachlor	0.15	0.2	0.2
Hexachlorobenzene	0.2	0.2	0.5
Lindane	2.0	1.0	7.0
Monocrotofos	0.02	0.02	-

Propoxur	-	0.05	-

'-' Data not available

Source: MOHFW (2004); FAO (2005); EPA (2000)

8. HEAVY METALS

Arsenic and Mercury

Arsenic is slowly excreted in the faeces, sweat and milk. Although accumulation occurs in exposed animals, the risk to consumers is small because the concentrations in the muscle are not above the maximum safe level for human consumption. Only the liver approaches the hazard level for man (Clarke and Clarke, 1967; Sabine andree et al. 2010).

Lead

Pb is present at low concentrations in most foods, offals and molluscus may contain higher levels (EC, 2008; Sabine Andree et al., 2010).

Cadmium

The EC regulations (EC, 2008) set maximum levels for cadmium in meat of bovine, sheep, pig and poultry as 0.05 mg/kg wet weight and for edible offal to these animals as 0.5 mg/kg for liver and 1.0 mg/kg for kidney, respectively (Sabine Andree et al., 2010).

Natural toxins

Toxins have a biological origin, mycotoxins, having attracted most attention due to their potential residuality in foodstuffs, including animal sub products.

Mycotoxin

Mycotoxins are products of toxigenic moulds growing in food and foodstuffs. These agents have caused many problems in livestock and the potential for residues in meat, poultry or dairy products is a cause of public concern (Graceys, 1992).

Aflatoxins

AFG1 is the most commonly produced and the most toxic (Shank, 1981) and transmission of toxic amounts into human food through meat and meat products does not appear likely (Ciegler et al., 1981). MRL regulated in different countries ranges from 0.05 to 0.5 μg/l; MRL also been established for aflatoxin consumed by ruminants (FAO, 2003). Experimental studies have shown that when animals consumed foodstuffs contaminated by high levels of aflatoxins, that it is difficult to final naturally, the liver and kidneys are the organs where most toxins become accumulated and their presence in muscle is scare (Bailly and Guerre, 2009).

Ochratoxins

Ochratoxins has been shown to be a teratogen in laboratory animals but has not been proved to the carcinogenic (Busby and Wogan, 1981). Another author reported detoxification may occur in ruminants through digestive flora action before absorption, thereby limiting the possibility that Ochratoxin A might be found in milk and beef (Bailly and Guerre, 2009).

Zearalenone

Alpha-zearalanol has been employed as growth promoter in cattle. However, a recent study has show that the presence of alpha-zearalenol in meat based foodstuffs for infants reached levels of 30.5 μg/kg (Meucci et al., 2010).

9. DETECTION OF RESIDUES IN MEAT AND MEAT PRODUCTS

9.1. Pesticides

Conventional methods

A number of analytical technique such as colorimetric method, Thin Layer Chromatography (TLC), High Performance – Thin Layer Chromatography (HP-TLC) etc., (Argauer et al., 1995; Bogialli et al., 2003; Pecorelli et al., 2004). GLC or GC-MS through normally

used for determination of non-volatile compounds (Organochlorine and Organophophorus pesticides), but also effectively utilized for determination of thermo-labile compounds such as synthetic pyrethroid and N-methyl carbamate pesticides (Biswas et al., 2007).

Modern methods

Enzymatic sensors, based on the inhibition of a selected enzyme, are the most extended biosensors used for the determination of these compounds (Choi et al., 2001, Andres and Narayanaswamy, 1997; Biswas et al., 2007; Mulchandani et al., 2001; Mallat et al., 2001; Biswas et al., 2007).

9.2. Veterinary drugs

Conventional methods

These include microbial growth inhibition assays, microbial receptors assays, enzymatic colorimetric assays, receptor binding assays, chromatographic methods and immunoassays. But microbial growth inhibition assays and later two methods are popular for monitoring of antimicrobial residues in meat (Mitchell et al., 1998; Biswas et al., 2007). Korsrud et al., (1998) found that screening for tetracycline was excellent with German three-plate test, the European Union four-plate and new Dutch kidney test instead Swab Test on Premises (STOP), Calf Antibiotic and Sulfa test (CAST) and the Fast Antibiotic Screen Test (FAST).

Modern methods

The Surface Plasmon Resonance (SPR) techniques are having a major impact on the development of new optical biosensors (Akkoyun et al., 2000; Setford et al., 1999; Hansen and Sorensen, 2000).

9.3. Mycotoxins

Conventional and Modern methods

TLC and HP-TLC is regularly used for determination of mycotoxins in foods (Delehanty and Ligler, 2002; Kumar et al., 1994).

10. CONCLUSION

The use of drug is wide in the food animals to control infections, diseases and improve the growth of the animal. But usages of drugs in food animals provide more disadvantages. It affect the human health, particularly relates to antibiotic resistance and toxicity. So better analytical techniques and MRL values will be needed to manage the use of drugs and other residues in meat production.

Ethical issues

Not applicable.

Informed consent

Not applicable.

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Conflict of Interest

The author declares that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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